HEATHKIT® MANUAL

for the

12-VOLT AUTOMOTIVE TIMING LIGHT

Model CI-1020

I-595-1364-04

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HEATH COMPANY • BENTON HARBOR, MICHIGAN

YOUR HEATHKIT 90-DAY FULL WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY
BENTON HARBOR, MI. 49022

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computers	(616) 982-3309

Prices and specifications subject to change without notice.

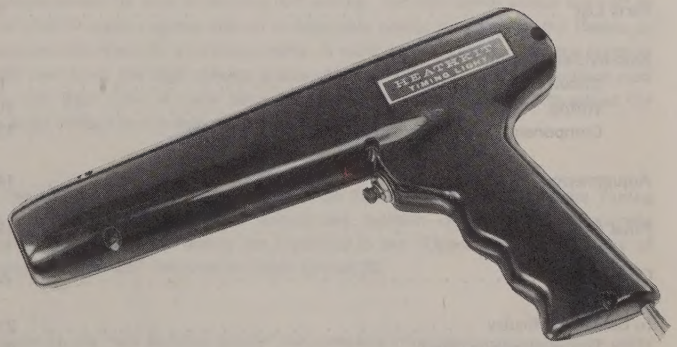
Assembly and Operation

of the

HEATHKIT

12-VOLT AUTOMOTIVE TIMING LIGHT

MODEL CI-1020



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model CI-1020 Automotive Timing Light is a self-contained flash unit powered by the vehicle battery and triggered by the spark plug ignition voltage. A specially designed adapter lets you easily connect the Timing Light either to a spark plug or directly to the distributor.

An intensified flash is produced by the Timing Light to illuminate the timing marks on the engine. The professional, or the do-it-yourself auto mechanic, desiring professional tune-up equipment will find the high intensity flash a pleasure to use even under full daylight conditions. The Timing Light can be used to set ignition distributor timing and to check centrifugal and vacuum spark advance.

An oscillator circuit provides for conversion of dc battery voltage to a pulsating dc voltage which is stepped up and then rectified to 600 volts dc to operate the flash tube. Engine ignition voltage is used only for triggering the flash tube. The result is a flash many times brighter than that of other timing lights which operate only from ignition spark voltage.

The housing of the Timing Light is made of high-impact plastic and carefully proportioned for ease of holding and aiming. The slim barrel allows the unit to be used in narrow spaces and an unbreakable plastic lens focuses the flashes to concentrate them on the timing marks. A spark gap on the circuit board protects the unit from any high voltage pulses which are over the ionization voltage used by the flash tube. A neon lamp on the circuit board allows you to adjust the supply voltage to the flash tube without using instruments.

This Manual also contains information on how to use and maintain the Timing Light. Essential facts about automotive ignition systems and an example procedure for engine timing are explained in the "Operation" and "Theory of Engine Operation" sections on Pages 20 and 26.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

Check each part against the following list. The key numbers correspond to the numbers in the Parts Pictorial (fold-out from Page 5).

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
RESISTORS				
1	1-49	1	22 Ω, 1/2-watt (red-red-black)	.15
2	2-143	1	133 kΩ, 1/2-watt, precision	1.00
	2-14	1	1 MΩ, 1/2-watt, precision	1.00
3	1-10-2	2	47 kΩ, 2-watt (yellow-violet-orange)	.20
	1-40-2	1	68 Ω, 2-watt (blue-gray-black)	.20
CAPACITORS				
4	23-112	1	2 μF paper	3.25
5	25-254	1	4 μF electrolytic	.85
6	27-61	1	.47 μF Mylar*	.60
ELECTRICAL PARTS				
7	54-287	1	Power transformer	4.40
8	57-27	2	Silicon diode	.75

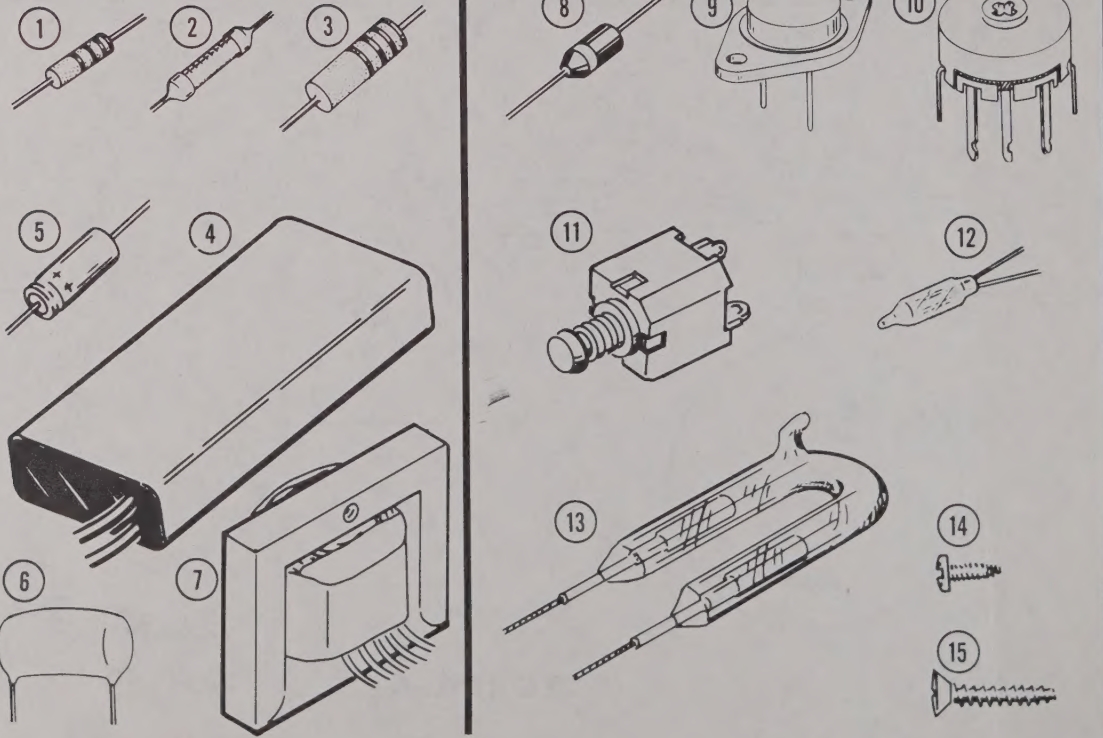
*DuPont Registered Trademark

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
Electrical Parts (cont'd.)				
9	417-278	1	PNP Germanium power transistor, selected	2.40
10	11-90	1	200 Ω control	1.15
11	64-84	1	Pushbutton switch	1.60
12	412-34	1	Neon lamp	1.50
13	412-73	1	Strobe lamp	5.25
HARDWARE				
14	250-163	4	4-40 x 5/16" self-tapping screw	.05
15	250-559	7	6-20 x 5/8" self-tapping screw	.05
16	250-89	2	6-32 x 3/8" screw	.05
17	254-1	2	#6 lockwasher	.05
18	254-5	1	Control lockwasher	.05
19	253-10	1	Control flat washer	.05
20	252-3	2	6-32 nut	.05
21	252-7	1	Control nut	.05

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
WIRE-SLEEVING				
	89-4	1	Power cord	1.00
	340-8	1	Bare wire	.05/ft
	344-52	1	Red hookup wire	.05/ft
	344-14	1	Red high voltage cable	.05/ft
MISCELLANEOUS				
22	73-64	2	Foam gasket	.40
	214-183	1	Housing	2.55
		Consisting of:		
23		*1*	*Housing half (component)*	
24		*1*	*Housing half (cover)*	
	85-564-1	1	Circuit board	1.05
25	260-14	1	Test clip	.20
26	73-11	1	Red insulator	.15
27	260-58	1	Battery cable clip (black insulation)	.45

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION	PRICE Each
Miscellaneous (cont'd.)				
	260-59	1	Battery cable clip (red insulation)	.45
28	432-197	1	Plug adapter	.20
29	413-30	1	Lens	.40
	390-388	1	Kit name label	.25
	390-391	1	Kit model label	.25
	391-34	1	Blue and white label	.15
			Parts Order Form	
			Kit Builders Guide	
			Manual (See front cover for part number.)	2.00
			Solder (Additional 3' rolls of solder, #331-6, can be ordered for 15 cents each.)	

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.


1
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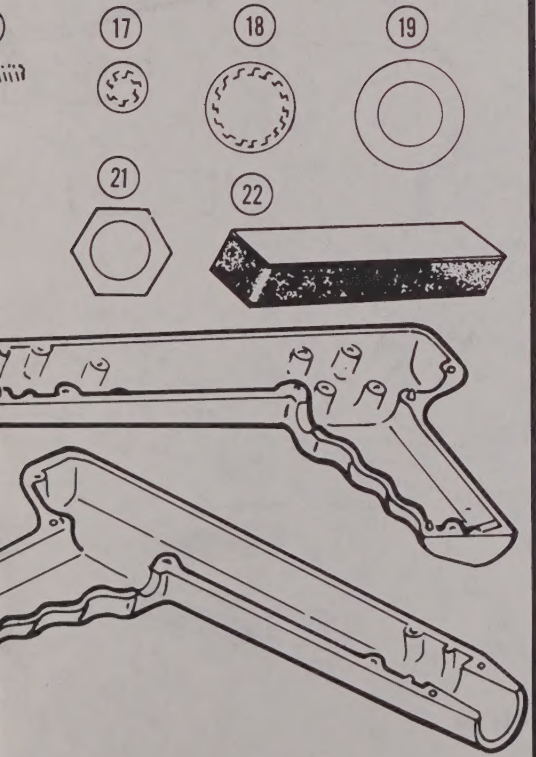
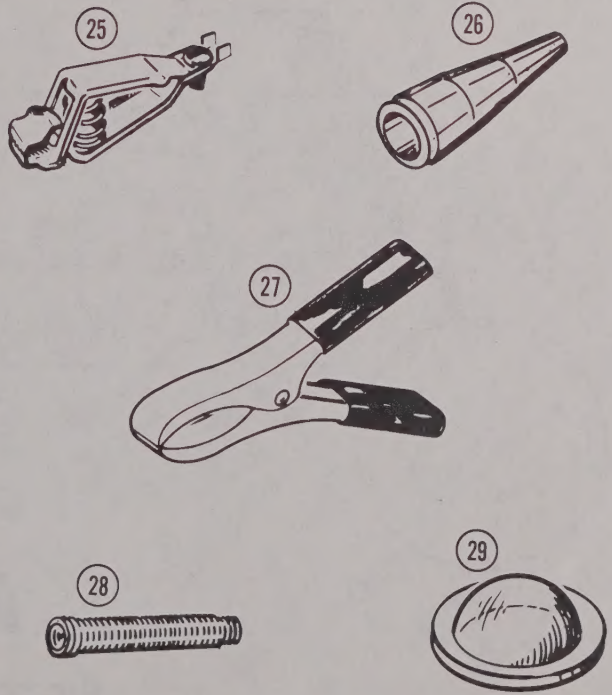
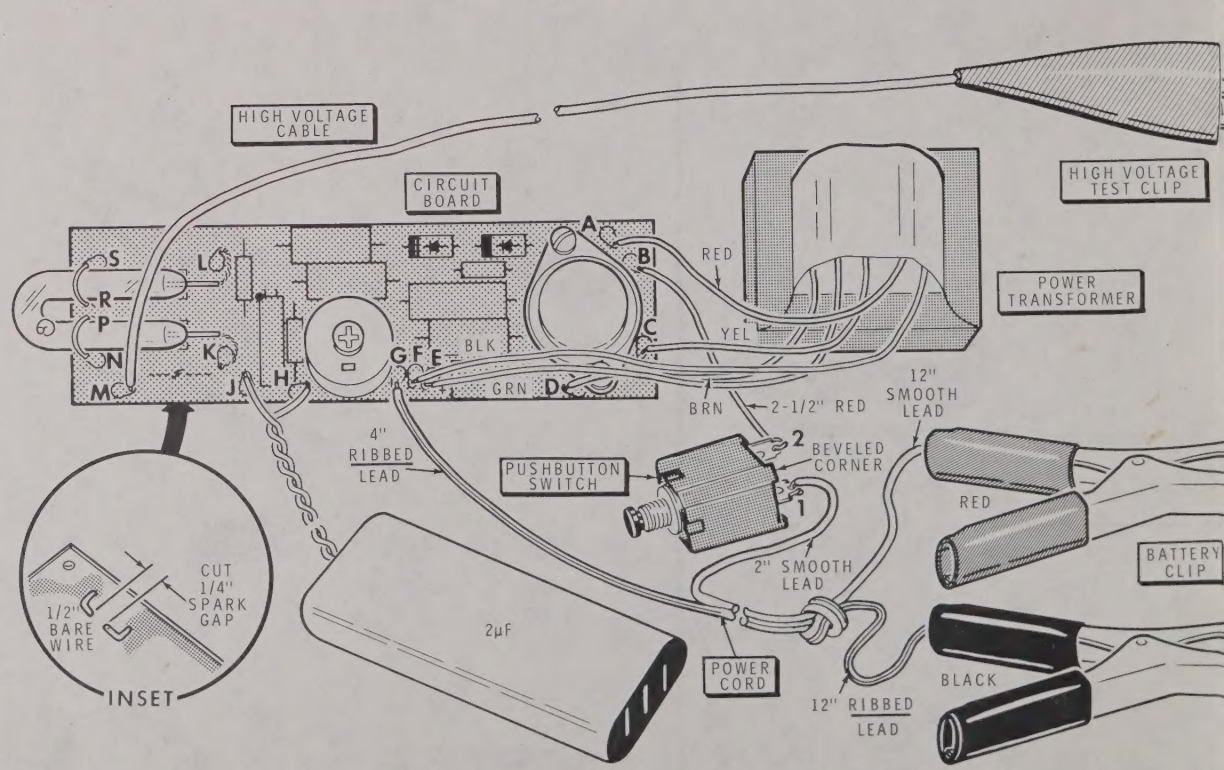
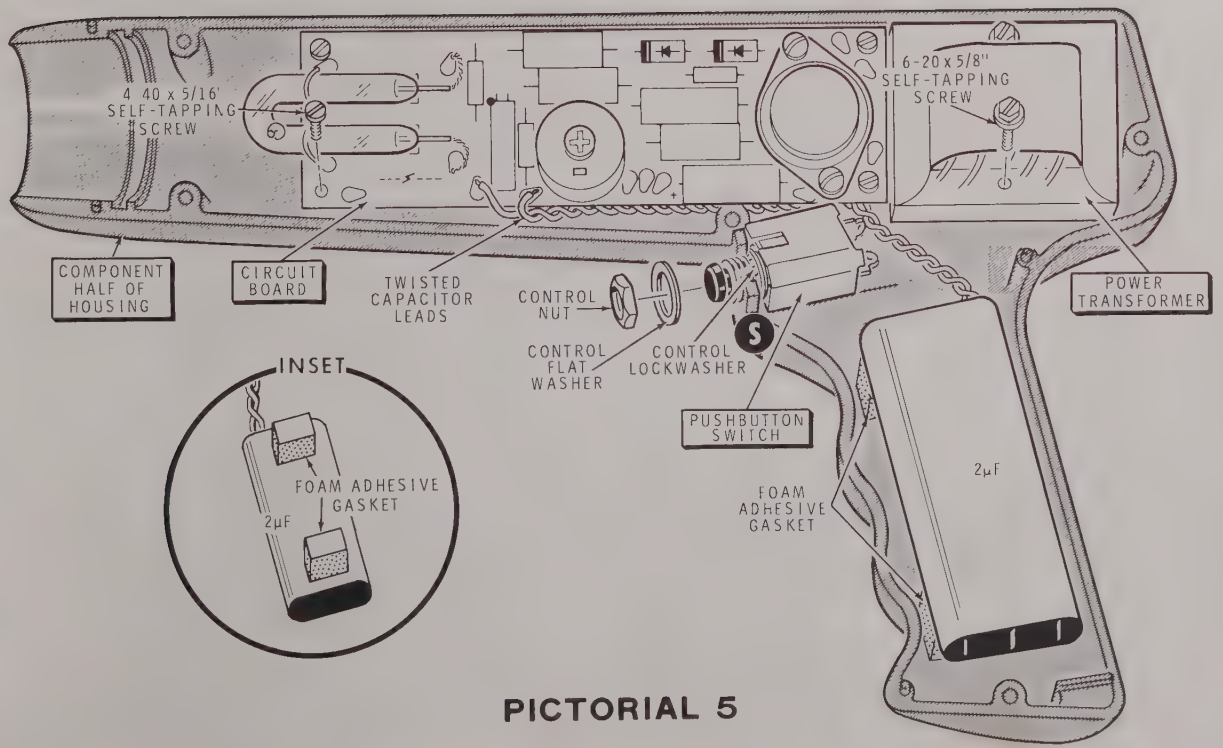
RIAL






HIGH VOLTAGE CABLE
CIRCUIT BOARD
HIGH VOLTAGE TEST CLIP
POWER TRANSFORMER
S
L
R
P
N
K
M
J
H
G
F
E
A
B
C
D
RED
YEL
BLK
GRN
BRN
2-1/2" RED
12" SMOOTH LEAD
4" RIBBED LEAD
PUSHBUTTON SWITCH
2
BEVELED CORNER
1
RED
BATTERY CLIP
2" SMOOTH LEAD
2μF
POWER CORD
BLACK
12" RIBBED LEAD
CUT 1/4" SPARK GAP
1/2" BARE WIRE
INSET

PICTORIAL 4


4-40 x 5/16" SELF-TAPPING SCREW
6-20 x 5/8" SELF-TAPPING SCREW
COMPONENT HALF OF HOUSING
CIRCUIT BOARD
TWISTED CAPACITOR LEADS
CONTROL NUT
CONTROL FLAT WASHER
CONTROL LOCKWASHER
S
PUSHBUTTON SWITCH
POWER TRANSFORMER
FOAM ADHESIVE GASKET
2μF
INSET
FOAM ADHESIVE GASKET
2μF

PICTORIAL 5

STEP-BY-STEP ASSEMBLY

Before you start the "Circuit Board Assembly," be sure to read the "Circuit Board Parts Mounting" and "Soldering" sections of the "Kit Builders Guide."

CIRCUIT BOARD ASSEMBLY

Components will be installed on the circuit board in the steps on Pages 7 through 9. Position all parts as shown in Pictorials 1 through 3. Follow the instructions carefully and read the entire step before performing each operation.

All resistors will be called out by resistance values (in Ω or kΩ); the color code will also be given for all resistors.

Capacitors will be called out by capacitance value (in μF) and type (electrolytic, disc, or Mylar).

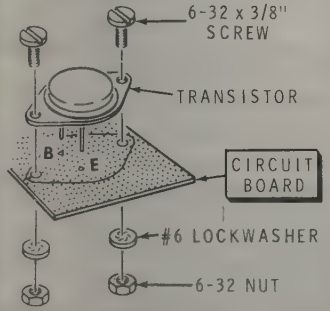
Locate the circuit board and position it lettered side up as shown in Pictorial 1. Then complete each step on Pictorial 1.

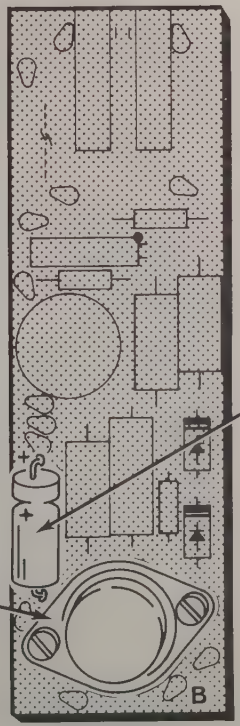
START

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

(N) Note that the two leads are closer to one end than to the other of the transistor body. Position the transistor so its two leads match the two holes marked B and E on the circuit board and so that it fits within the outline on the circuit board. Then install the transistor on the circuit board, using two 6-32 x 3/8" screws, two #6 lockwashers, and two 6-32 nuts.

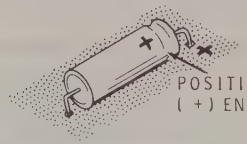




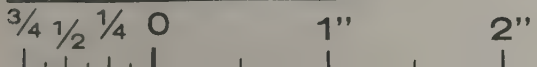
PICTORIAL 1

CONTINUE

(N) 4 μF electrolytic. Position the capacitor as shown with the positive lead in the positive (+) marked hole.

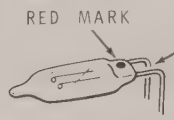


(N) Solder the leads of the components to the foil and cut off the excess lengths.

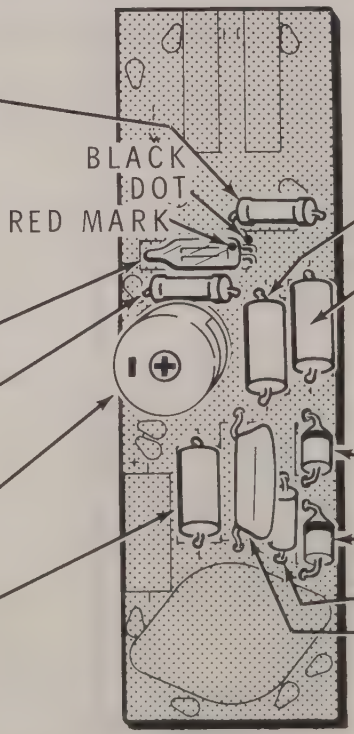


START

- ( ) 133 kΩ, precision resistor.
- ( ) Position the neon lamp with the red mark as shown and bend the two leads down.



- ( ) Install the neon lamp with its red mark next to the black dot on the circuit board.
- ( ) 1 MΩ, precision resistor.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) 200 Ω control. Solder the control lugs to the foil.
- ( ) 68 Ω, 2-watt, (blue-gray-black).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

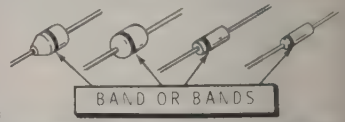


PICTORIAL 2

CONTINUE

- ( ) 47 kΩ, 2-watt (yellow-violet-orange).
- ( ) 47 kΩ, 2-watt (yellow-violet-orange).

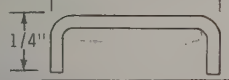
NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. ALWAYS POSITION THIS END AS SHOWN IN THE PICTORIAL.



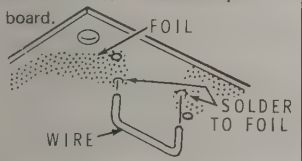
- ( ) Silicon diode (#57-27).
- ( ) Silicon diode (#57-27).
- ( ) 22 Ω (red-red-black).
- ( ) .47 μF Mylar capacitor.
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

START

( ) Bend a 1" bare wire to the dimensions shown.

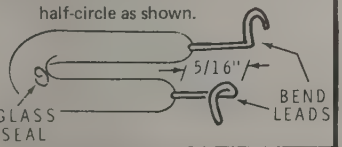


( ) Install this wire here from the foil side. Position the 1/2" portion of the wire 1/8" from the foil, and solder the ends to the foil. Cut off the excess wire ends on top of the board.

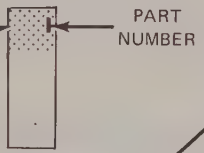


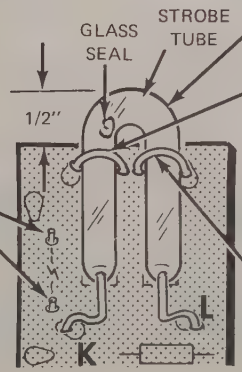
NOTE: Be careful in handling the strobe tube to prevent damage to the glass seal or the tube.

( ) Bend the strobe tube leads into a half-circle as shown.



The steps performed in this Pictorial are in this area of the circuit board.

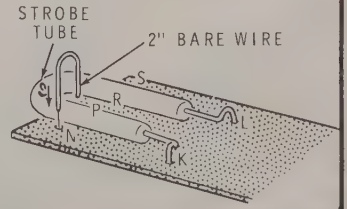




CONTINUE

( ) With the glass seal facing up, position the end of the strobe tube 1/2" from the edge of the circuit board. Then install the leads at K and L and solder them to the foil. Cut off the excess lead lengths.

( ) Bend a 2" bare wire into a "U" shape. Install the wire in holes N and P over the strobe tube, and draw the wire snugly against the tube. Solder the wire ends to the foil and cut off the excess lengths.



( ) Using the remaining bare wire, repeat the previous steps at points R and S.

PICTORIAL 3

WIRING

Refer to Pictorial 4 (fold-out from Page 6) for the following steps.

( ) Twist the leads of the 2 μF capacitor as shown.

( ) Connect either lead of the capacitor to hole J in the circuit board (S-1).

( ) Connect the other lead of the capacitor to hole H (S-1).

( ) Refer to Detail 4A and cut the leads of the power transformer to the following lengths. Measure each lead from the point where it emerges from the transformer.

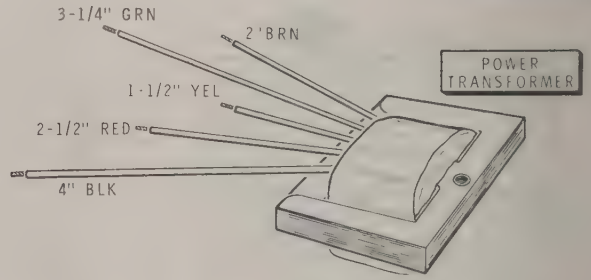
Black	4"	Green	3-1/4"
Red	2-1/2"	Brown	2"
Yellow	1-1/2"		

NOTE: In the following steps, whenever you are told to remove 1/4" of insulation from the ends of wire leads, twist the small wire strands together after removing the insulation and then melt a small amount of solder on the wire ends to hold the wires together.

( ) Remove 1/4" of insulation from the free ends of the transformer leads.

( ) Connect the black transformer lead to hole F (S-1).

( ) Connect the green transformer lead to hole E (S-1).



Detail 4A

( ) Connect the brown transformer lead to hole D (S-1).

( ) Connect the yellow transformer lead to hole C (S-1).

( ) Connect the red transformer lead to hole A (S-1).

( ) Cut off the excess lead lengths.

( ) Cut a 2-1/2" length of red hookup wire and remove 1/4" of insulation from each end.

( ) Connect one end of the wire to point B and solder it to the foil.

( ) Refer to Pictorial 4 and place the pushbutton switch near the circuit board. Position the beveled corner of the switch as shown. Connect the 2-1/2" red wire coming from point B of the circuit board to lug 2 of the switch (S-1).

Refer to Detail 4B part A for the following steps.

( ) Locate the power cord. At one end of the cord, separate the two leads for a length of 4".

( ) Cut off and discard 2" of the smooth lead. Remove 1/4" of insulation from both of the leads at this end of the cord.

( ) At the other end of the power cord, separate the two leads for a length of 12" and remove 1/4" of insulation from both of the lead ends.

( ) Tie a knot, as shown, in this end of the cord at the point where the leads are separated.

Refer to Detail 4B part B for the following steps.

( ) Locate the battery clip with the black insulation on the handles. Slide the insulation off one of the handles and onto the ribbed 12" power cord lead.

( ) Connect the ribbed lead end to the inner solder lug of one of the clip handles (S-1).

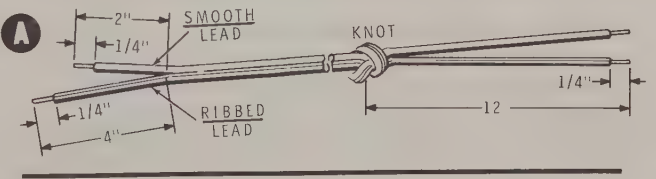
( ) Using pliers, bend the tabs of the battery clip over the cord insulation as shown.

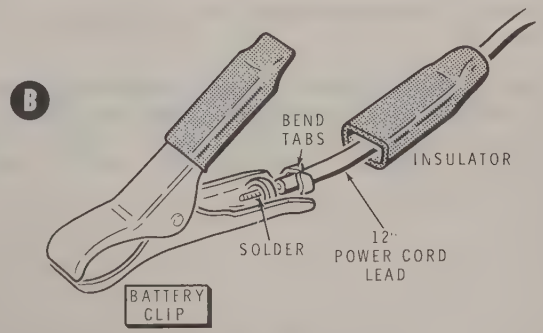
( ) Slide the black insulation over the battery clip handle.

( ) In a similar manner, install the battery clip with the red insulation on the smooth 12" power cord lead.

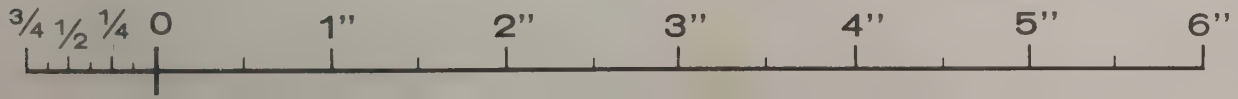
( ) At the other end of the power cord, connect the smooth 2" lead to lug 1 on the pushbutton switch (S-1).

( ) Connect the ribbed 4" lead to hole G in the circuit board (S-1). Cut off the excess lead length.





Detail 4B



Refer to Detail 4C for the following steps.

( ) Remove 1/4" of insulation from each end of the red high voltage cable.

( ) Slide the red insulator on the high voltage cable as shown.

( ) Remove the screw in the test clip and discard it.

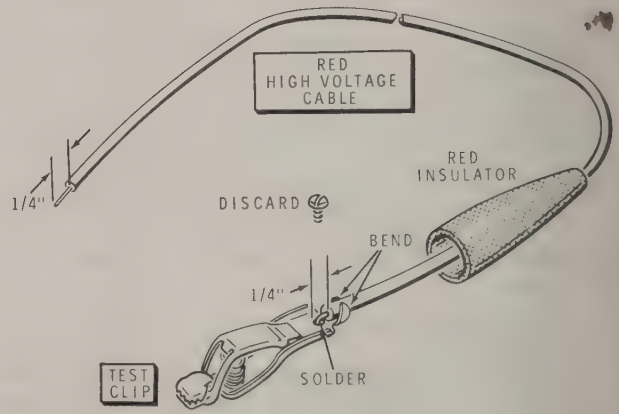
( ) Connect one end of the cable to the hole in the test clip (S-1).

( ) Using pliers, bend the flaps of the test clip over the high voltage cable as shown. Slide the red insulator over the test clip.

( ) Connect the other end of the high voltage cable to hole M in the circuit board (S-1).

( ) Turn the circuit board over. Then refer to the inset drawing on Pictorial 4 and cut a 1/4" gap in the center of the 1/2" bare wire as shown.

This completes the wiring of the Timing Light. Check it to be sure all connections are soldered.



Detail 4C

COMPONENT HOUSING ASSEMBLY

Refer to Pictorial 5 (fold-out from Page 6) for the following steps.

( ) Position the component half of the housing as shown.

( ) Position the twisted capacitor leads under the circuit board and place the circuit board and the power transformer, in the housing half, as shown.

( ) Place four 4-40 x 5/16" self-tapping screws in the corner mounting holes of the circuit board. Carefully tighten each of these screws a little at a time to secure the circuit board to the housing. Do not overtighten these screws.

( ) In a similar manner, mount the power transformer to the housing with two 6-20 x 5/8" self-tapping screws.

( ) Place the control lockwasher, control flat washer, and control nut on the pushbutton switch. Position them so the nut and flat washer will be on the outside of the housing and the lockwasher will be on the inside of the housing when the switch is installed in the next step.

( ) Slide the pushbutton switch into the cutout on the housing at location S. Then carefully tighten the control nut to hold the switch on the housing.

( ) Cut one length of foam adhesive gasket into two equal lengths.

( ) Position the 2 μF capacitor so the twisted leads are on the left side of the capacitor as shown in the inset drawing.

( ) Peel off the backing from one side of the lengths of foam adhesive gasket. Press one piece of the gasket onto the 2 μF capacitor near one end of the capacitor, as shown.

( ) In a similar manner, press the other length of foam gasket onto the capacitor near the other end.

( ) Peel off the backing on the upper side of these foam gasket lengths, turn the capacitor over, and press the capacitor into the housing handle. Be sure the upper edge of the capacitor is positioned away from the pushbutton switch.

This completes the assembly of the component housing. Proceed to "Adjustments."

ADJUSTMENTS

NOTE: The Automotive Timing Light can be adjusted using the neon lamp on the circuit board or a dc voltmeter. If a dc voltmeter is not available, perform the following steps under "Adjustments Using the Neon Lamp." If a dc voltmeter is available, perform the steps under "Adjustments Using a dc Voltmeter." After completing the proper adjustment section, proceed to "Final Assembly" on Page 18.

DANGER! SHOCK HAZARD

Avoid contact with the two leads of the strobe tube when the battery clips are connected to the battery.

NOTE: If you do not obtain the proper response in the following adjustments, refer to the "In Case of Difficulty" section on Page 23 to locate and correct the trouble. After you locate the trouble and correct it, return to this section of the Manual and complete the adjustments.

ADJUSTMENTS USING THE NEON LAMP

Refer to Figure 1 for the following steps.

( ) Temporarily secure the high voltage cable and the power cord to the handle with a rubber band or masking tape. This will prevent breaking the cable and the power cord where they connect to the circuit board.

( ) Using a small screwdriver, turn the 200 Ω control fully clockwise.

NOTE: In the following steps, a separate 15 volt dc power supply (of at least 1.5 ampere capacity) or the battery of your automobile (with the engine running) can be used.

( ) Connect the black battery clip to the negative (–) terminal of your power supply or to the negative terminal of the battery in your automobile.

( ) Connect the red battery clip to the positive (+) terminal of the power supply or to the positive terminal of the battery.

( ) Hold the pushbutton switch pressed in (a faint squealing sound is normal) and slowly rotate the 200 Ω control counterclockwise until the neon lamp just begins to glow.

( ) Release the pushbutton switch and disconnect the battery clips.

( ) Remove the rubber band or masking tape holding the high voltage cable and the power cord to the handle.

This completes "Adjustments Using the Neon Lamp." Proceed to "Final Assembly."

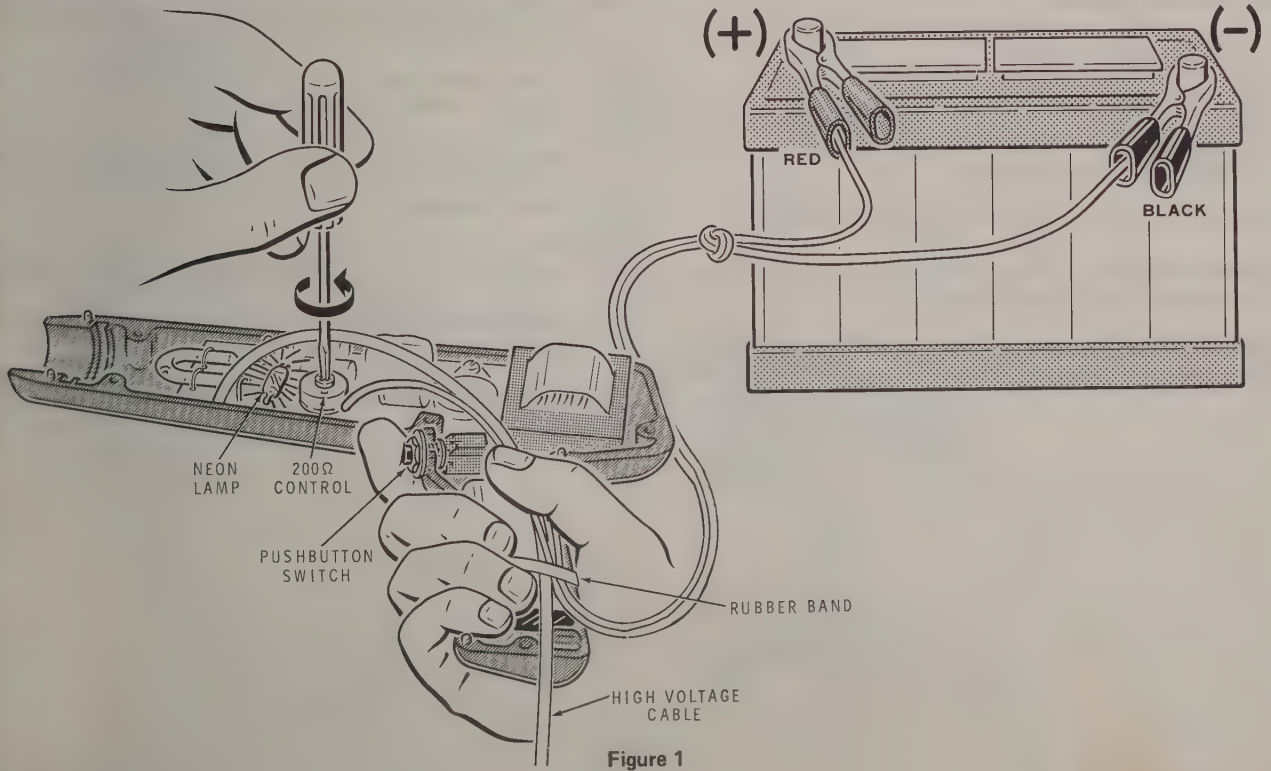

(+)
(–)
RED
BLACK
NEON LAMP
200Ω CONTROL
PUSHBUTTON SWITCH
RUBBER BAND
HIGH VOLTAGE CABLE

Figure 1

USING A DC VOLTMETER

Refer to Figure 2 for the following steps.

( ) Temporarily secure the high voltage cable and the power cord to the handle with a rubber band or masking tape while performing the following adjustments. This will prevent breaking the cable and the power cord where they connect to the circuit board.

( ) Using a small screwdriver, turn the 200 Ω control fully clockwise.

( ) Connect the negative (–) voltmeter lead to the strobe tube lead at point K and the positive (+) voltmeter lead to point L.

NOTE: In the following steps a separate 15 volt dc power supply (of at least 1.5 ampere capacity) or the battery of your automobile with the engine running can be used.

( ) Connect the black battery clip to the negative (–) terminal of your power supply or to the negative terminal of the battery in your automobile.

( ) Connect the red battery clip to the positive (+) terminal of the power supply or to the positive terminal of the battery.

( ) Hold the pushbutton switch pressed in (a faint squealing sound is normal) and slowly rotate the 200 Ω control counterclockwise until the dc voltmeter reads 600 volts.

( ) Release the pushbutton switch and disconnect the battery clips. Also disconnect the dc voltmeter leads from the strobe tube at points L and K.

( ) Remove the rubber band or masking tape holding the high voltage cable and the power cord to the handle.

This completes the "Adjustments." Proceed to "Final Assembly."

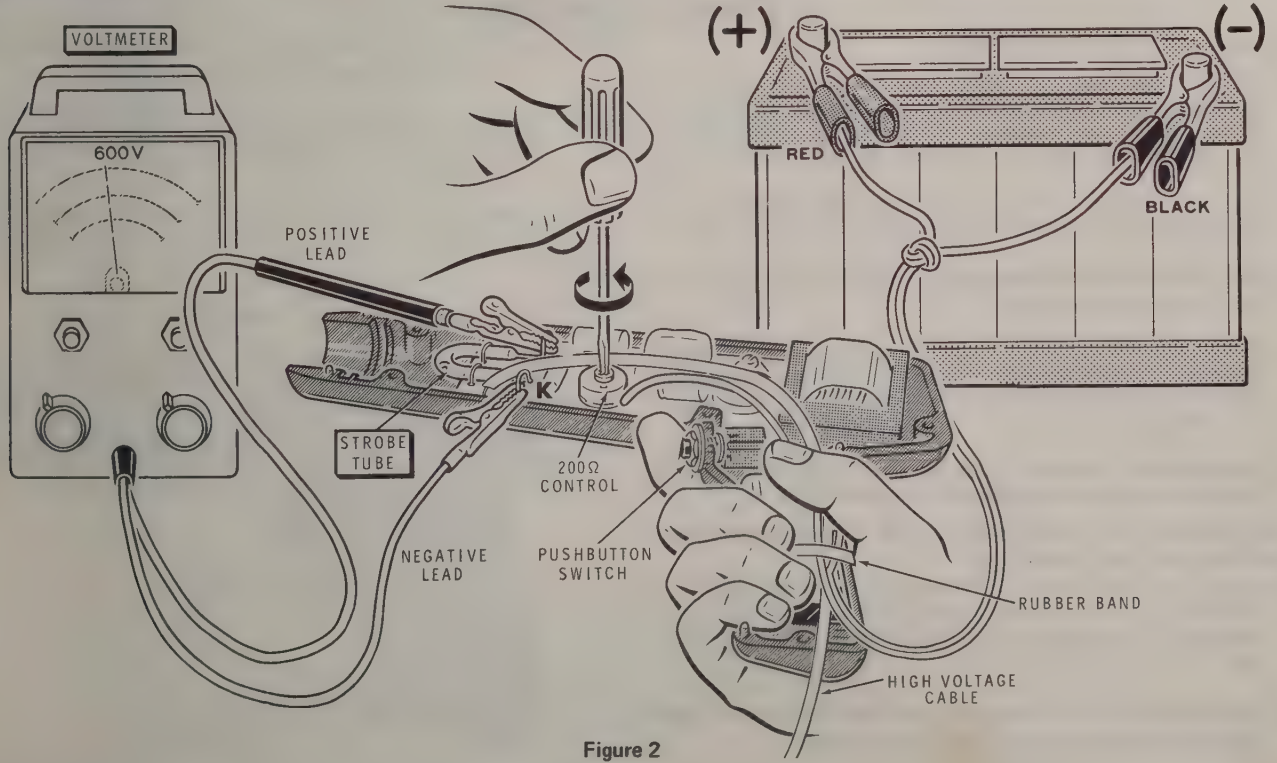

VOLTMETER
600V
POSITIVE LEAD
STROBE TUBE
K
200Ω CONTROL
NEGATIVE LEAD
PUSHBUTTON SWITCH
(+)
(−)
RED
BLACK
RUBBER BAND
HIGH VOLTAGE CABLE

Figure 2

FINAL ASSEMBLY

Refer to Pictorial 6 for the following steps.

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label on the inside of the housing half at the location shown. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.

( ) Peel off the backing from only one side of the remaining length of foam gasket. Press the gasket onto the 2 μF capacitor at the location shown.

( ) Place the lens in the component half of the housing with the flat side of the lens facing the strobe tube.

( ) Route the power cord and the high voltage cable past the pushbutton switch and the foam gasket on the capacitor as shown. Locate the cord and the cable between the threaded hole in the handle and the rear edge of the housing.

( ) Route the green and black transformer wires over the 4 μF electrolytic capacitor and away from the edge of the component housing.

Then carefully place the housing half over the lens, the pushbutton switch, the power cord, and the high voltage cable.

( ) Position the power cord and the high voltage cable in the cutout of the housing half as shown in inset drawing #1. Be sure the housing half is positioned so it matches the component half before performing the next step.

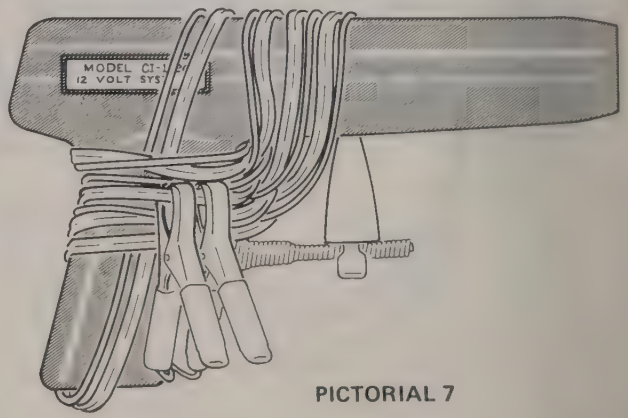
( ) Install the five 6-20 x 5/8" screws in the housing half and carefully tighten them a few turns at a time. Do not overtighten the screws.

( ) Carefully remove the backing paper from the kit name label. Press the label in place in the recessed area of the barrel as shown.

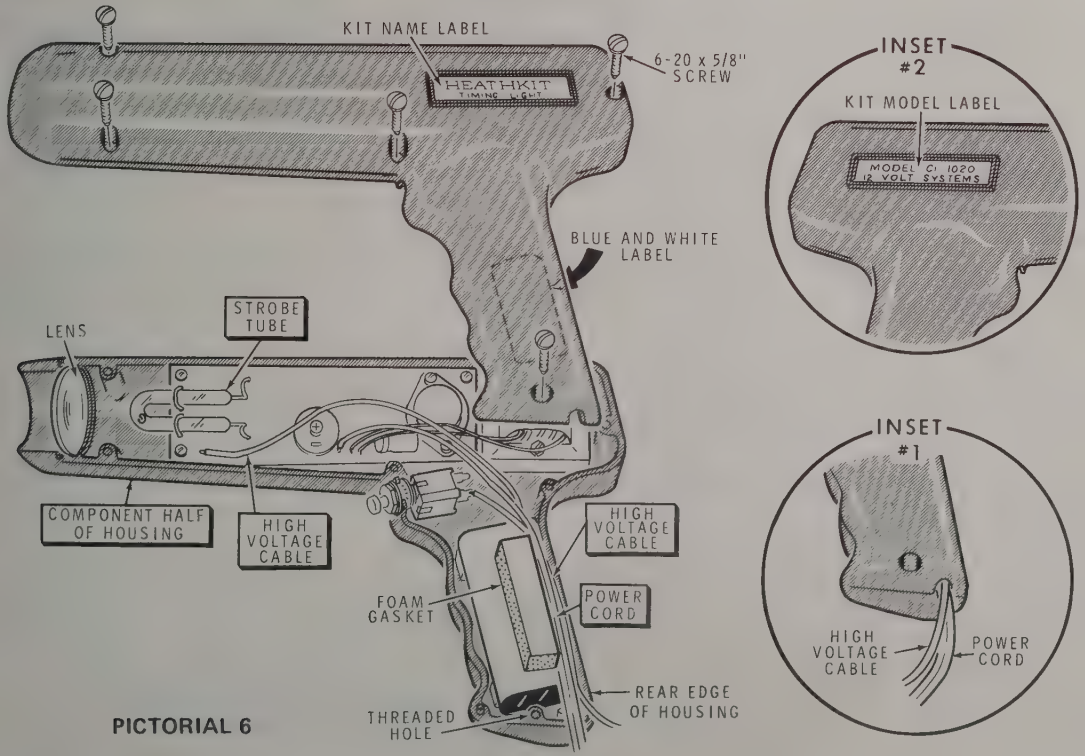
( ) Carefully remove the backing from the kit model label. Press the label in place in the recessed area on the opposite side of the housing as shown in inset drawing #2.

NOTE: When not in use, wrap the power cord and high voltage cable in a "Figure 8" around the handle and barrel of the Timing Light as shown in Pictorial 7.

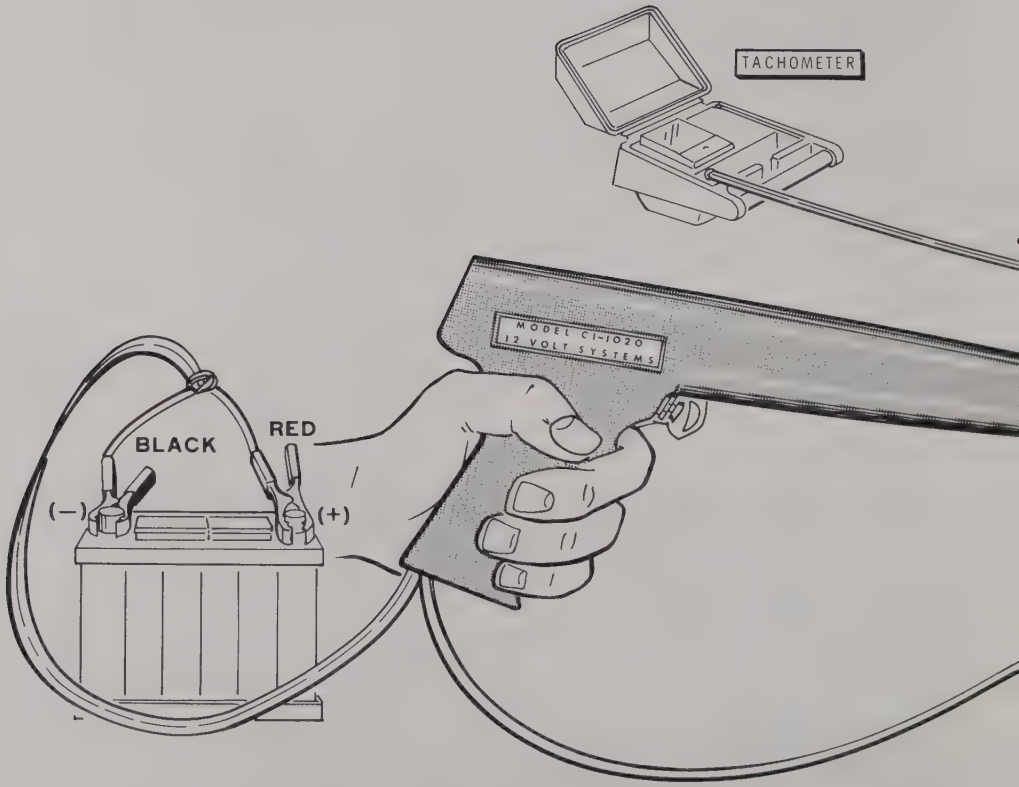
This completes the assembly of your Timing Light.



PICTORIAL 7


KIT NAME LABEL
HEATHKIT
TIMING LIGHT
6-20 x 5/8" SCREW
BLUE AND WHITE LABEL
STROBE TUBE
LENS
COMPONENT HALF OF HOUSING
HIGH VOLTAGE CABLE
FOAM GASKET
HIGH VOLTAGE CABLE
POWER CORD
REAR EDGE OF HOUSING
THREADED HOLE
INSET #2
KIT MODEL LABEL
MODEL
INSET #1
HIGH VOLTAGE CABLE
POWER CORD

PICTORIAL 6


TACHOMETER
MODEL CI-1020
12 VOLT SYSTEMS
BLACK
RED
(−)
(+)

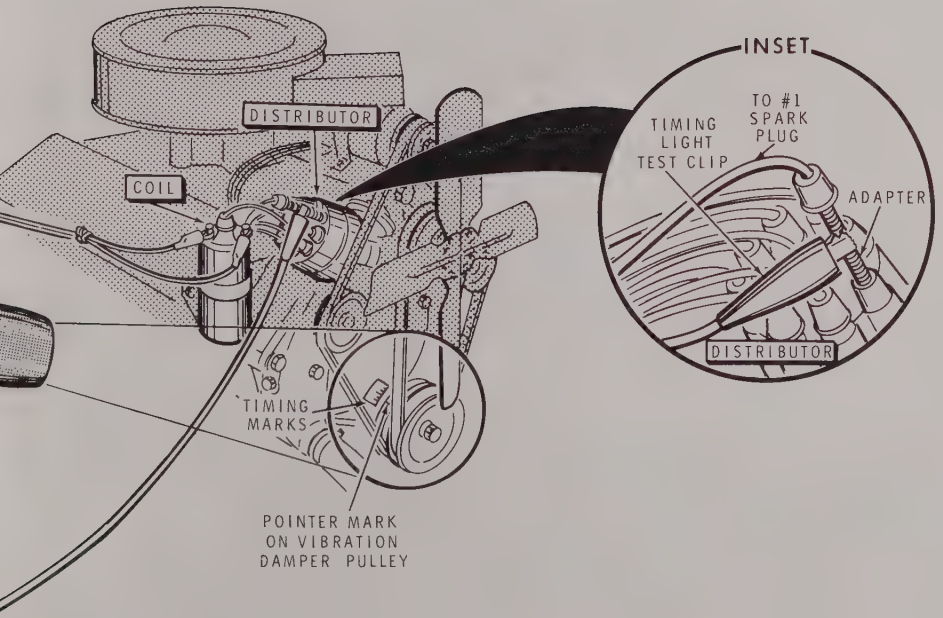

INSET
DISTRIBUTOR
COIL
TIMING
LIGHT
TEST CLIP
TO #1
SPARK
PLUG
ADAPTER
DISTRIBUTOR
TIMING
MARKS
POINTER MARK
ON VIBRATION
DAMPER PULLEY

FIGURE 3

OPERATION

Refer to Figure 3 (fold-out from this page) for an illustration of the operation and use of the Timing Light on an automobile engine.

NOTE: It may be helpful to refer to technical publications, books, and magazines for additional timing information and techniques.

ENGINE TIMING SPECIFICATIONS

Obtain the engine timing specifications for your car's engine before attempting any timing adjustments.

If you wish, record your car's specifications on the "Engine Timing Specifications Chart" on Page 33.

PRECAUTIONS

While doing engine timing, avoid personal injury or damage to the Timing Light, its power cord, and high voltage lead by observing the following precautions:

1. Avoid touching any high voltage points on the engine ignition system.
2. Keep away from the fan and the fan belt.
3. Be sure the Timing Light, its power cord and high voltage cable are correctly positioned as shown in Figure 4 so they are clear of the fan and fan belt.
4. Avoid touching the exhaust manifold of the engine.
5. Do not lay the Timing Light on the engine.
6. Do not look directly at the lens of the Timing Light when it is operating.

OPERATING CONSIDERATIONS

The following considerations apply to using the Timing Light:

1. The Timing Light can be used in daylight at a range of up to two feet from the timing marks.
2. The high voltage test clip or the adapter should not touch the engine or the chassis of the car. This will not damage the Timing Light. However, the Light will not work until the test clip or the adapter is removed from contact with any metal part of the car.
3. The pushbutton switch should not be taped down. Use the pushbutton switch only when doing timing adjustments or when checking the timing.
4. Do not attempt to do timing adjustments until other engine tuning work has been completed.
5. Operating the engine at over 2,000 rpm with the Timing Light hooked up to the ignition system will cause a loss of brightness in the Timing Light and cause overheating of the Timing Light components. Operation of the Timing Light at engine speeds over 2,000 rpm should only be intermittent.
6. The Timing Light should not be used in temperatures below 0°F. The electronic components may be damaged.

TIMING PROCEDURE EXAMPLE

Read through this section completely before attempting to time your engine.

Refer to Figure 4 (fold-out from this page) for an illustration of the hookup of the Timing Light to an automobile ignition system.

NOTE: The following basic step-by-step procedure is only an example.

1. Refer to the engine timing specifications.

2. Start the engine and allow it to warm up to normal operating temperature.

3. Use a tachometer to set the engine to the specified idle rpm.

NOTE: In the following step, use the plug adapter with the Timing Light for all U.S.A. made spark plugs. European spark plugs may require a special adapter which can be purchased from an automotive supply store.

4. Remove the distributor lead from the #1 spark plug (see the engine specifications for the location of the #1 plug in the firing order of the engine) and place the large end of the plug adapter on the spark plug. Place the distributor lead on the other end of the adapter and clip the high voltage test clip of the Timing Light onto the adapter.

   NOTE: The adapter can also be installed on the distributor outlet to the #1 spark plug. Remove the distributor lead from the #1 spark plug outlet on the distributor. Place the small end of the plug adapter on the distributor outlet. Place the distributor lead on the other end of the adapter and clip the high voltage test clip of the Timing Light onto the adapter.

5. Connect the battery clip with black insulation to the negative (–) battery terminal and the battery clip with red insulation to the positive (+) battery terminal.

6. Start the engine again and operate it at the specified idle speed.

7. Aim the Timing Light at the timing marks and press the pushbutton switch.

8. If the timing reference mark lines up with the specified timing mark, no adjustment is necessary. Turn the engine off. However, if the reference mark does not line up with the timing mark, the engine needs timing. Proceed to step 9.

9. NOTE: Do not rotate the distributor after loosening the locking screw. (IF you wish, mark the position of the distributor before loosening the screw so you can return it to the original adjustment point.)

   Turn the engine off and carefully loosen the locking screw on the distributor clamp. Leave the screw tight enough so that the distributor will not change position by itself while the engine is running.

10. Start the engine.

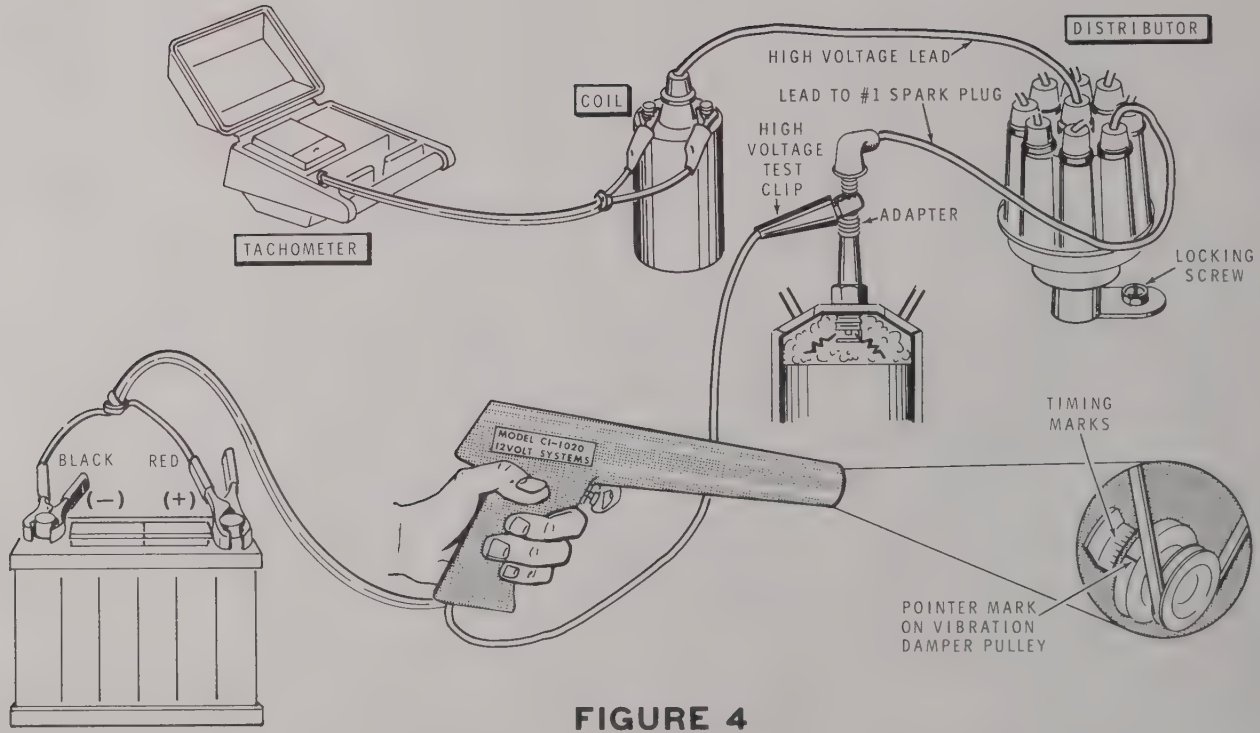

TACHOMETER
COIL
DISTRIBUTOR
HIGH VOLTAGE LEAD
LEAD TO #1 SPARK PLUG
HIGH VOLTAGE TEST CLIP
ADAPTER
LOCKING SCREW
BLACK
(−)
RED
(+)
MODEL CI-1020
12VOLT SYSTEMS
TIMING MARKS
POINTER MARK ON VIBRATION DAMPER PULLEY

FIGURE 4

11. Rotate the distributor to cause the timing reference mark to line up with the specified timing mark.

12. Tighten the distributor locking screw and then recheck the engine timing, using the Timing Light.

13. NOTE: If the distributor of your engine has a centrifugal spark advance, perform this step. If it does not have a centrifugal spark advance, disregard this step and proceed to step 14.

    Increase the engine speed smoothly and observe the timing marks with the Timing Light aimed at them. The matching timing mark should move as the engine speed is increased. The direction of movement of the timing mark should be opposite to the direction of rotation of the damper pulley.

14. Reconnect the vacuum line if it was disconnected and plugged in an earlier step.

15. Set the engine speed at higher than normal idle speed. While the Timing Light is aimed at the timing marks, open the throttle suddenly and then let it spring closed. The matching timing marks will momentarily move in the direction of rotation of the engine (retards spark) when the engine is suddenly speeded up. With normal speed increases, the vacuum control advances the spark and adds to the spark advance caused by the centrifugal advance mechanism. A sudden increase in engine speed causes the intake manifold vacuum to drop to a low value which momentarily retards the spark.

IN CASE OF DIFFICULTY

Refer to the "Identification Photograph" on Page 32 and the "Circuit Board X-Ray View" on Page 31 for help in locating parts on the circuit board.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by carefully checking all connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide."

3. Check the values of the parts. Be sure that the proper parts have been wired into the circuits at each location.

4. Check electrolytic capacitors and diodes to be sure they are installed properly, with the marked end of each one positioned as it is shown in the Pictorial.

5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring, or for solder bridges between foils on the circuit board.

6. Check the transistor with a transistor tester or by substitution of a transistor of the same type known to be good.

7. A review of the "Circuit Description" may also help you locate a difficulty.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

TROUBLESHOOTING PROCEDURE

Difficulties with the Timing Light (see Troubleshooting Chart) are due to: 1. The Timing Light, 2. The hookup to the ignition system, or 3. The engine or ignition system.

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE
Flash tube does not light (no squealing sound).	1. Connections to battery. 2. Oscillator transistor Q1. 3. SW1.
Flash tube does not light (squealing sound can be heard).	1. Adapter connection to distributor lead or spark plug. 2. Distributor lead broken or insulation on lead broken. 3. #1 spark plug not firing. (Place the adapter on another plug to check the flash tube.) 4. Wires at points N, P, and R, S, not touching the flash tube. 5. No voltage on flash tube. 6. Flash tube positioned incorrectly on circiit board. (Reduce 1/2" dimension until flash tube lights.) 7. Flash tube faulty.
Flash tube lights only dimly.	1. Low voltage to flash tube (check R1 calibration control adjustment). 2. Flash tube faulty.
Flash tube flashes do not correspond to firing of #1 spark plug.	1. Adapter connected to incorrect plug and distributor lead. (Check the engine specifications for correct plug to be used in engine timing.)
"Clicking" sound in Timing Light, engine is missing.	1. 1/4" spark gap on circuit board too close.

SPECIFICATIONS

Useful Light Range	Up to 2 feet in daylight.
Engine Speed Range	Full flash brightness up to 2000 rpm. Operation above 2000 rpm should be intermittent only.
Triggering Requirements	Direct connection to spark plug specified for use in timing of auto engine ignition system.
Connecting Cables	Battery cable with clips (7 feet). High voltage cable with clip (5 feet).
Adapter/Connector	Connects to either a spark plug or the distributor.
Power Requirements	12 volt automotive storage battery or separate 15 volt dc power supply with 1.5 ampere capacity.
Size	6-1/2" high x 10" long x 2" wide.
Weight	1 lb. 4 oz.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

THEORY OF ENGINE OPERATION

HOW TIMING WORKS

This section of the Manual explains the principles of operation of a 4-cycle engine (used in most automobiles). To understand how ignition timing works in an engine, read this section thoroughly.

Refer to Figure 5 for an illustration of the basic principle of operation of a 4-cycle (4 strokes per cycle) engine. Only the #1 cylinder of the engine is shown. All the other cylinders of the engine operate in the same manner, going through the same four strokes per cycle as the #1 cylinder does. The sequence of operation of the other cylinders is determined by the engine design and by the firing order of the engine.

(1) Intake Stroke

On the intake stroke, the piston moves down and the intake valve of the engine opens, admitting the fuel mixture to the engine.

(2) Compression Stroke

On the next stroke the piston moves up toward the head of the engine and compresses the fuel mixture. At a certain "timed" instant as the piston is still moving up, the spark plug fires and ignites the fuel. The distributor determines the timing of the spark.

(3) Power Stroke

The fuel mixture which has been ignited by the spark plug requires approximately 1/350th of a second to burn completely. Depending on the speed at which the engine is operating, the fuel will still be burning for a certain amount of time after the piston reaches top dead center and has started down on the power stroke. The force of expansion of the burning fuel pushes the piston down and gives the engine its power.

(4) Exhaust Stroke

When the piston moves up again, the exhaust valve opens, releasing the burned fuel. This prepares the engine to take in fuel again for the intake stroke which follows the exhaust stroke.

Top Dead Center (TDC)

The crankshaft of the engine rotates through 180 degrees for each stroke of the piston. At the highest point of piston travel, the piston is at "top dead center." All ignition timing, as specified by the engine manufacturer, is measured in degrees of crankshaft rotation from the point where the piston is at top dead center.

PRINCIPLE OF OPERATION OF 4-CYCLE (STROKE) ENGINE

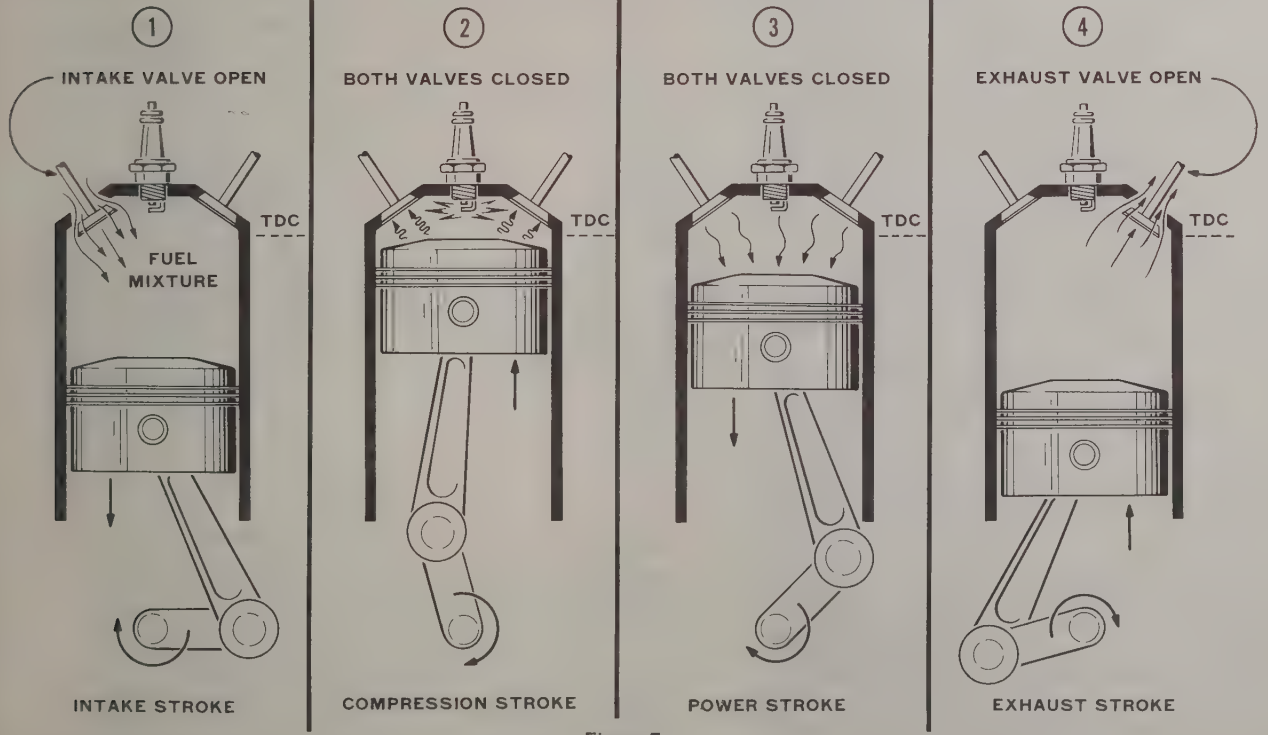


Figure 5

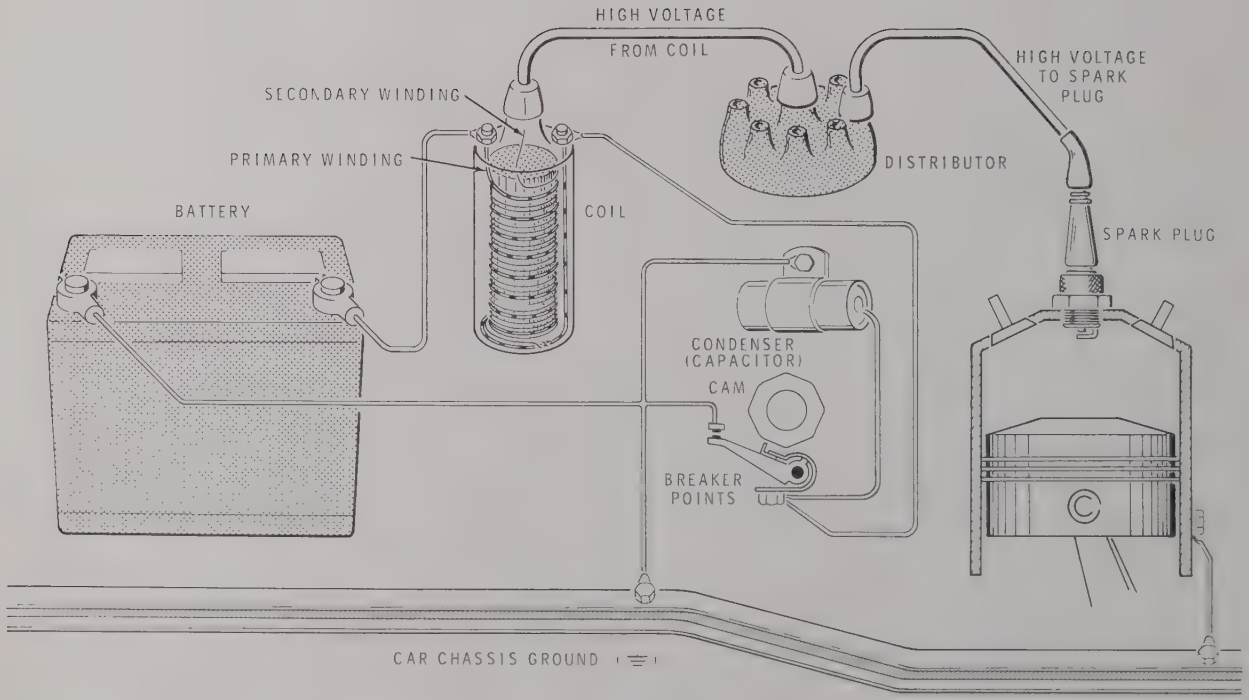

HIGH VOLTAGE
FROM COIL
HIGH VOLTAGE
TO SPARK
PLUG
SECONDARY WINDING
PRIMARY WINDING
DISTRIBUTOR
BATTERY
COIL
SPARK PLUG
CONDENSER
(CAPACITOR)
CAM
BREAKER
POINTS
CAR CHASSIS GROUND

FIGURE 8

ENGINE TIMING SETTINGS

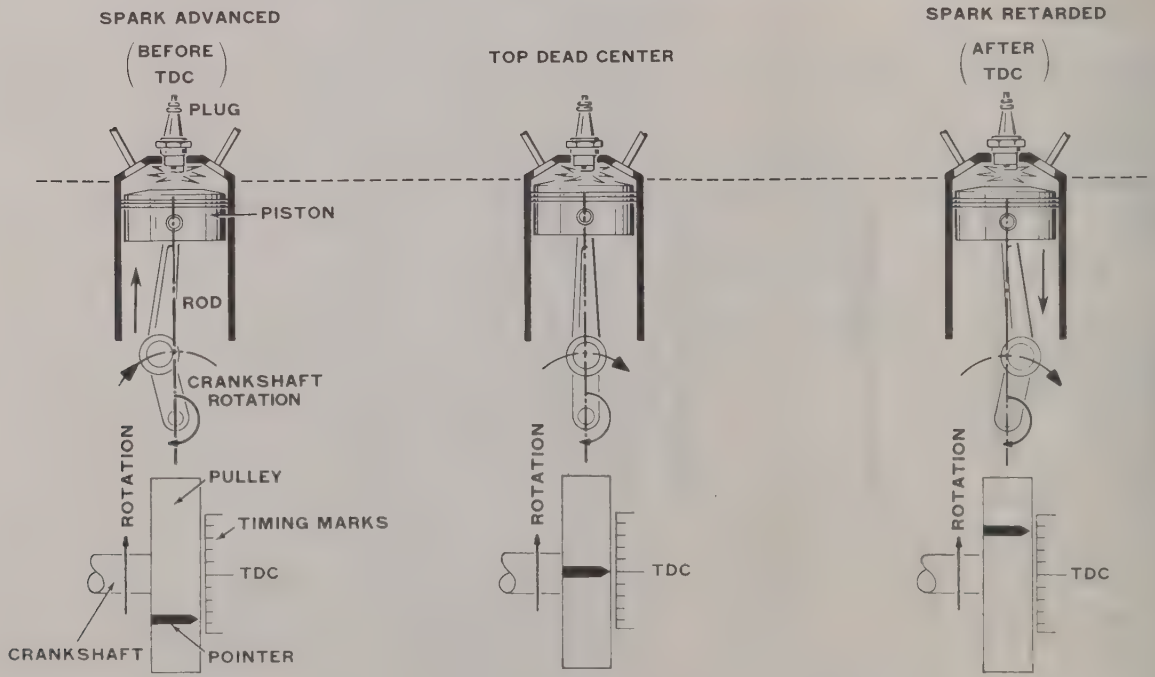


Figure 6

Advancing or Retarding the Spark (Distributor Adjustment)

As shown in Figure 6, the time when the spark plug fires can be changed by manually adjusting the distributor. The terms "advanced" and "retarded" are used to designate the direction in which the spark timing is being changed. Causing the spark to occur at a point earlier in the rotation of the crankshaft is "advanced" and later is "retarded." The spark is advanced or retarded automatically by the centrifugal and automatic vacuum advance sections of the distributor. (See "Operation" on Page 20.) The centrifugal spark advance mechanism works from the speed of the engine. It advances the breaker cam of the distributor as the engine is speeded up. The automatic vacuum spark advance works from engine vacuum. It advances the distributor breaker plate with an increase in engine speed. When the throttle is opened suddenly, the vacuum spark control momentarily retards the spark to allow the engine to run smoothly.

Using the Timing Marks on the Engine

Figure 7 shows example timing marks on an engine. These marks are calibrated to the angular rotation of the crankshaft relative to the position of the piston in the #1 cylinder before or after TDC. With the engine running, a timing light is aimed at the timing marks. Due to the stroboscopic effect, the pointer mark (or pointer) will appear to line up with one of the calibrated timing marks. The timing mark which matches the pointer mark indicates the position of the spark during the stroke of the piston in the #1 cylinder only.

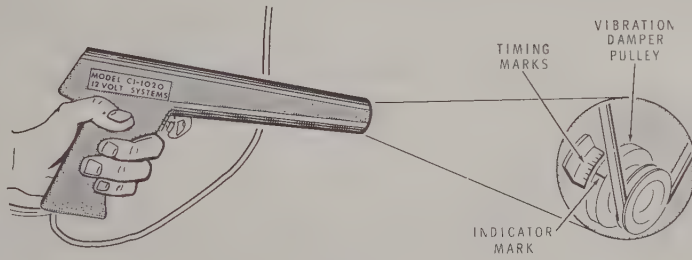
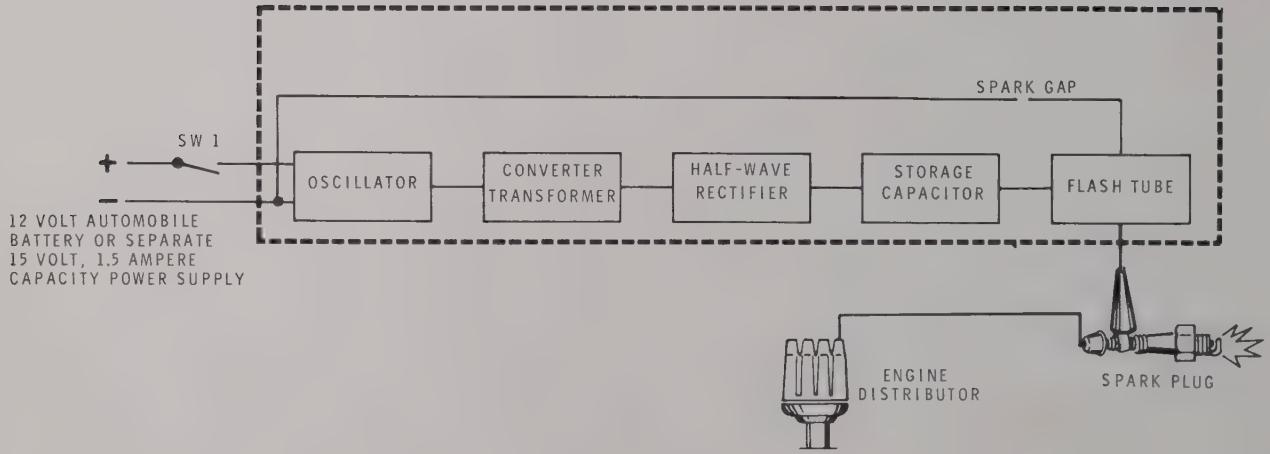


Figure 7

What the Timing Light Does

The flash tube of the Timing Light is fired by the high voltage from the distributor and is directly connected either to the #1 spark plug of the engine or to the distributor outlet to the #1 spark plug. The flash of the Timing Light illuminates the rotating damper pulley and the timing marks when the firing voltage for #1 spark plug occurs at the distributor as shown in Figure 8 (fold-out from Page 28). As the pulley passes the timing marks, the pointer or the mark on the pulley will appear to align with one of the timing marks. If the engine needs timing, the distributor is adjusted (by rotating the distributor housing) so that the pulley mark then aligns with the proper timing mark as specified by the engine manufacturer. NOTE: On some engines the timing marks are located on the vibration damper pulley and the reference mark is a stationary pointer located near the pulley.

BLOCK DIAGRAM OF TIMING LIGHT CIRCUIT



CIRCUIT DESCRIPTION

Refer to the Block Diagram, (fold-out from this page) and the Schematic (fold-out from Page 33) as you read the following descriptions.

TIMING LIGHT

The voltage from the storage battery of the car is applied through switch SW1 to oscillator transistor Q1. R1, the 200 Ω control in the base-to-collector circuit of Q1, varies the bias voltage of Q1. This bias voltage controls the oscillation frequency of Q1 and thus Q1's output, a pulsating dc to the primary winding of converter transformer T1, is controlled. This pulsating dc induces a 600 volt ac voltage in the secondary winding of T1.

The output voltage of T1 is applied to diodes D1 and D2, which operate as half-wave rectifiers and change the 600 volts ac to a pulsating dc voltage. The 2 μF capacitor, C3, charges to the 600 volts, which is also applied to flash tube V1. The tube does not fire at this time because the voltage is less than the self-ionization voltage of the tube. An additional voltage in the form of a high voltage trigger pulse is taken from the #1 spark plug of the engine when the plug fires.

The spark plug voltage has a peak of 4,000 to 6,000 volts when the engine is idling. When the spark voltage is applied to the flash tube, the Xenon gas in the tube is ionized. The tube conducts which allows the 2 μF capacitor to discharge through the tube. A brilliant flash is produced that is approximately 10 microseconds in duration.

Resistors R6 and R7 form a voltage divider network for the voltage adjustment using the Neon lamp and control R1.

AUTOMOTIVE IGNITION SYSTEM

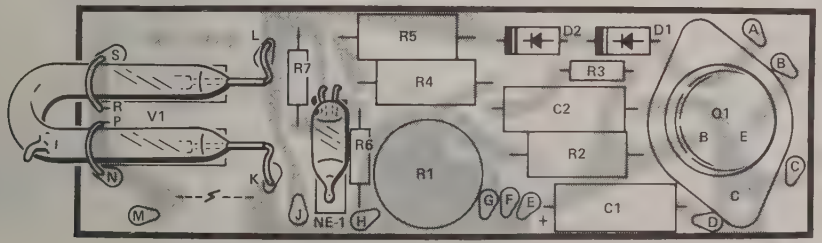
As shown in Figure 8, the ignition system of an automobile engine consists of the battery-charging circuit, the spark coil, the distributor, and the spark plugs. Voltage for the system is provided by the storage battery. This voltage is applied to one end of the primary (low voltage) windings of the spark coil. The primary windings are also connected to the breaker points of the distributor. A lead (high voltage) from the secondary windings of the spark coil is connected to the distributor rotor. From the distributor, individual high voltage leads connect to each of the spark plugs of the engine.

When the distributor breaker points are closed, current flows through the points and the primary of the ignition coil. This causes a magnetic field to build up in the coil. Then, as the points are opened (by the distributor shaft cam) the current stops flowing and the magnetic field collapses creating a high voltage (approximately 20,000 volts) in the secondary winding of the coil. This voltage is conducted to the spark plugs through the distributor rotor and distributor leads. The specific timing (instant the plug fires) is set by adjusting the distributor. The Timing Light is used to stroboscopically illuminate the timing marks (scale of degrees) on the engine and thus to determine accurately the angular position of the crankshaft when the spark plug fires. Engine timing specifications state at what position (in degrees of rotation relative to TDC) the spark plug should fire for proper timing.

CIRCUIT BOARD X-RAY VIEW

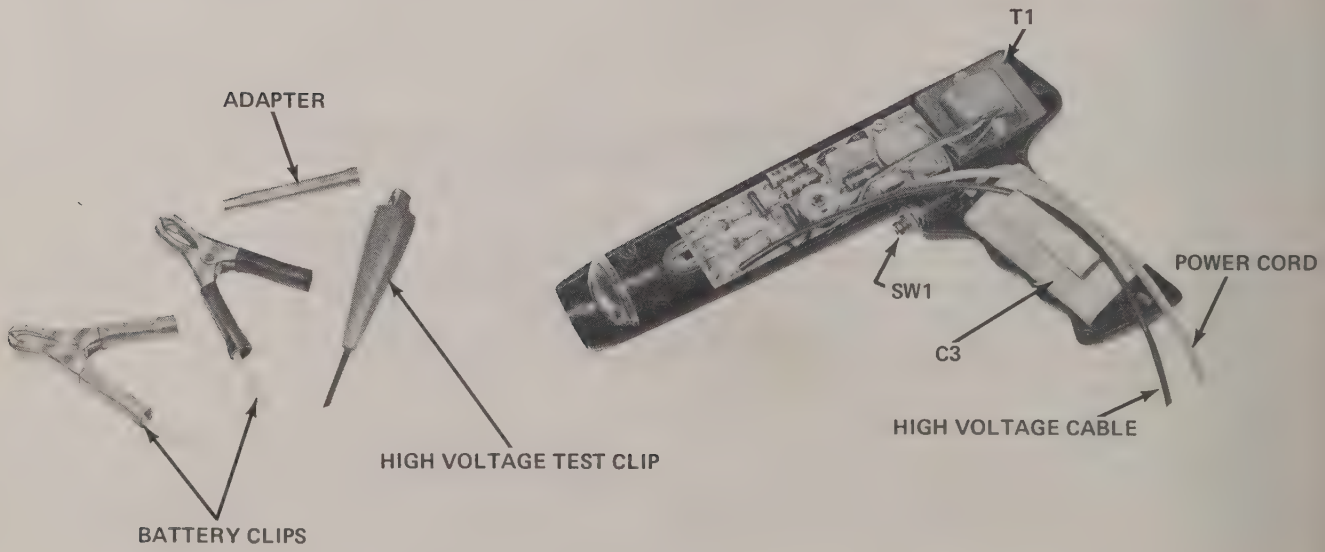
NOTE: To determine the value (22 Ω, 4 μF, etc.) of one of these parts, you may proceed in either of the following ways.

1. Refer to the place where the part is installed in the Step-by-Step instructions.
2. Note the identification number of the part (R-number, C-number, etc.). Then locate the same identification number next to the part on the Schematic. The value, or "Description," of most parts will be near this number.



(FROM COMPONENT SIDE)

IDENTIFICATION PHOTOGRAPH



ENGINE TIMING SPECIFICATIONS CHART

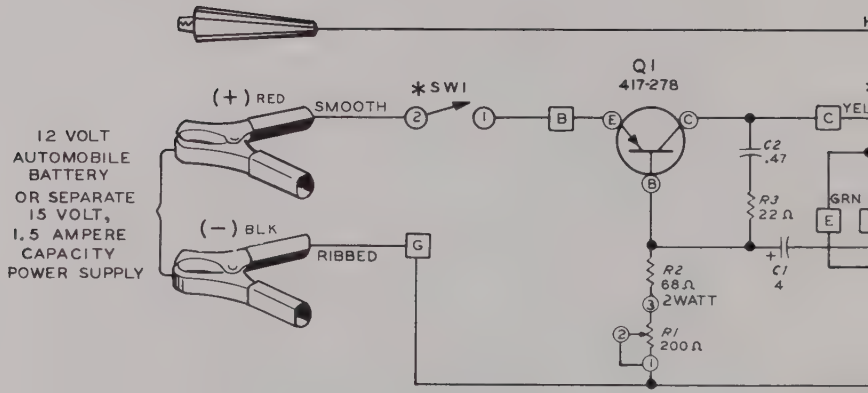
CAR			IGNITION TIMING			DEGREES PER TIMING MARK	VACUUM SPARK ADVANCE LINE DISCONNECTED		IDLE SPEED (RPM)	TRANSMISSION SELECTOR		LOCAT SPA
YR.	MAKE	MODEL AND ENGINE	°BTDC$_1$	TDC$_2$	°ATDC$_3$		YES	NO		NEUTRAL	DRIVE	

1. BTDC = BEFORE TOP DEAD CENTER
2. TDC = TOP DEAD CENTER (Highest point of piston travel in cylinder).
3. ATDC = AFTER TOP DEAD CENTER

OTHER SPECIFICATIONS _____

NOTES _____

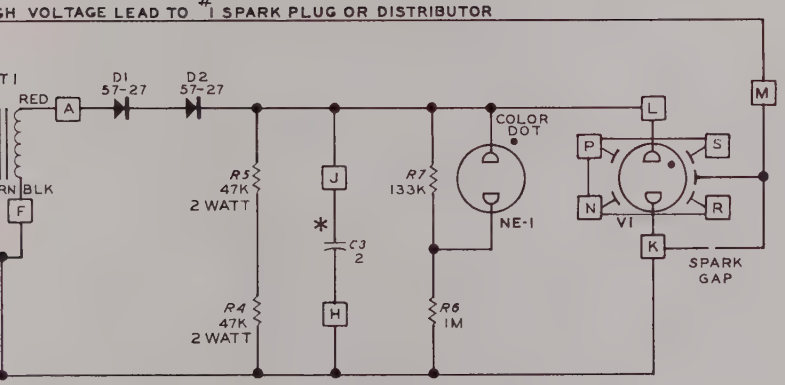
ION OF #1 K PLUG



* ITEMS NOT ON CIRCUIT BOARD

BASING DIAGRAM FOR Q1

SCHEM
HE
12-VOLT
TIM
MOD



TIC OF THE
ATHKIT®
AUTOMOTIVE
NG LIGHT
EL CI-1020

NOTES:

1. RESISTOR VALUES ARE IN OHMS (K=1000). RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN µF.
3. ☐ THIS SYMBOL INDICATES CONNECTION TO CIRCUIT BOARD.
4. * ITEMS NOT ON CIRCUIT BOARD.

CUT ALONG DOTTED LINE

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

SEND TO:

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only):
616 982-3571

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

Total enclosed $_____

- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

THIS FORM IS FOR U.S. CUSTOMERS ONLY — OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH
Schlumberger

MP MASTER
MA22864

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

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